HANFORD AIR CLEANING OPERATIONS

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I. INTRODUCTION

At a previous Air Cleaning Seminar, a presentation was made of the program which led to the development and adoption at Hanford of the silver reactor and the Fiberglas filter as methods for the intensive removal of radioiodine and particulate contamination from process gas streams. The initial evaluation data of the plant-scale equipment, which established that the iodine removal efficiency of the silver reactor was greater than 99.99 per cent and the filtration efficiency of the deep bed Fiberglas filter was in the order of 99.99 per cent, were also presented at that meeting. At the completion of the evaluation of this equipment, approximately 2-1/2 years ago, the Hanford Stack Gas Group was disbanded and the personnel assigned to other activities.

Although there has been no formal program conducted by personnel of the Technical Section since that time, there are two items associated with this period which appear appropriate to today's discussions. The first is a brief summary of the operating experience which has been obtained at Hanford with the deep bed fibrous glass filters and silver reactors, and the second is an alternative filter equipment which is presently under consideration for the filtration of the ventilation air of Separations Plants.

II. OPERATING EXPERIENCE WITH PLANT DECONTAMINATION EQUIPMENT

A. Glass Fiber Filters

There are at the present time eleven fibrous glass filters in operation at Hanford which could be described as major plant installations; in addition, there is a large number of secondary or auxiliary applications. All of the major units are in applications involving continuous operation. The service lives of these filters presently range from one to three years. All of the original units are still operating and there have been no significant variations in the operating characteristics. Likewise, there have been no maintenance requirements for any of the filters.

B. Silver Reactors

A total of seven silver reactors have been installed at Hanford. The basis of operation is the use of a silver bearing, reacting bed at an elevated temperature. For the purpose of economy of silver, Berl saddles which have been coated with silver nitrate are used for the reactor packing. The iodine reacts chemically to form silver iodide and is retained within the bed. The rapidity of the reaction and the low vapor pressure of iodine above silver iodide at the operating temperature are primary factors in the success of the process.

At last year's meeting, the monitoring data which established that the filtration efficiency of the plant scale Fiberglas filter was in the order of 99.99% were presented. The time then available did not permit the presentation of the actual monitoring data of the plant silver reactors and the results were only mentioned. It would, therefore, be desirable to take this opportunity to present this information. The data are contained on the first slide.

SLIDE I

PERFORMANCE OF A PLANT SILVER REACTOR

Sample Period	Sample Flow Rate (scfm)	Radioiodine in Scrubber Sol. (uc).	Total Off Gas Flow (scfm)	Total Radioiodine to Stack (curies)
1	1.0	0.48	100*	0.00005
2	1.0	0.35	90	0.00003
3	1.0	1.72	90	0.00015
4	1.0	4.73	87	0.00041
5	1.0	2.68	85	0.00023
			Total	0.00087

* Flow was not recorded for this period....100 scfm assumed for purposes of the calculation.

Note: A value of 100 curies has been substituted for the actual radioiodine content of the metal and the monitoring values adjusted accordingly.

Reactor Efficiency > 99.99%.

One difficulty was experienced in the operation of the silver reactors. Appreciable quantities of radioiodine were detected passing through three of the first reactor installations after approximately two months' operation. The situation was investigated and it was determined that the difficulty had been caused by an overheating of the reactor assemblies which resulted in the silver nitrate film melting and running off the Berl saddle packing. A lowering and closer control of the temperature of the gas streams passing to the reactors has essentially eliminated this difficulty.

During this operating period, it has also been determined that a high removal efficiency can be quite easily restored to a reactor which is beginning to permit the passage of a significant amount of radioiodine. When an appreciable quantity of radioactive iodine is detected downstream from a reactor assembly, the unit is cooled and a 5 molal silver nitrate solution is sprayed over the top of the reactor packing. The treatment requires only a few hours and is sufficient to restore the efficiency to the 99.99 per cent range. The various reactor installations have operated for periods ranging from three months to two years between such treatments. The variation in the operating periods is due to the different quantities of material which have been passed through the units and individual operating circumstances, such as an accidental overheating of an assembly.

In summary, the Hanford operating experience with the deep bed Fiberglas filters and silver reactors has been highly satisfactory, both from the viewpoints of the intensive contamination removal which they have provided and the low maintenance requirements.

III. ALTERNATIVE FILTER EQUIPMENT

The second item is concerned with alternative filter equipment arrangements which are currently being considered for the treating of ventilation air streams. In the first Separations Plants constructed at Hanford, the vent gases from the process vessels were discharged to the cells and then to the main ventilation air stream. When the presence of radioactive particles in the plant environs was demonstrated, the problem was met by the filtration of the ventilation air through deep bed sand filters.

A corollary study performed during the subsequent Fiberglas filter development program established that the process vessel vent gases constituted the primary source of the radioactive aerosol present in the effluent ventilation air. This information was incorporated into the design of a plant which was constructed approximately two years ago to the extend that a separate vessel vent system was provided to permit the removal of the contaminated aerosol at its source. This was accomplished by manifolding the vessel vent lines and passing the composite off-gases through a deep bed, high-efficiency, Fiberglas filter. A sand filter was also provided for the filtration of the main ventilation air stream.

The inclusion in this plant of both high-efficiency Fiberglas units for the separate filtration of the vessel vent gases and a sand filter for the decontamination of the main ventilation air stream, together with appropriate monitoring facilities, made it possible to assess the relative contributions of the two systems to the particulate decontamination of the effluent stack gases. When the design for a new Separations Plant was initiated approximately a year ago, this information was consulted to determine whether any possible improvements in the ventilation system were indicated. At that time, the plant having individual filtration facilities for the vessel vent system had been in operation for one year. The data showed that the average radioactivity content of the ventilation air prior to its passage through the sand filter at this installation was less than the activity present in the air streams downstream from the original plant sand filters.

In view of this information, an alternative equipment for filtering the ventilation air was proposed. This arrangement is shown on the following slide.

The primary advantage to be gained through the use of such a standby filter unit is that it is no longer necessary to incorporate a large life expectancy factor into the equipment and an appreciable savings in fabrication and installation costs can therefore be realized. A comparative cost estimate has been made for a sand filter and an emergency unit, each having a capacity of 100,000 cfm and has shown a cost differential of approximately $500,000 in favor of the standby unit.

The decision was made a year ago by the people responsible for the design of the new Separations Plant that a detailed study would be made of the ventilation system of the plant presently providing separate filtration facilities for the vessel vent gases and the main ventilation air stream and that the results of this study would guide future construction. During the past year, process changes have necessitated an almost continual alteration and replacement of equipment in this reference plant. This has resulted in a more frequent occurrence of significant activity levels in the ventilation air than was experienced during the first year's operation. The detailed study of the long term radioactivity level of the ventilation air and the characteristics of the contaminated aerosol, as they are related to the feasibility of this standby filter arrangement, has been made the responsibility of the group under the direction of Frank Adley and it is presently planned to conduct this investigation before the end of the year.

The consideration of Technical Section personnel of alternative filter equipment is based upon two primary factors. These factors are that a ventilation air stream be treated in accord with both the decontamination required and the present state of equipment development, rather than through the use of equipment which will undeniably do the job but which may represent an unwarranted overdesign or antedated design.

In this regard, it should be noted that the particular alternate, the standby filter which has just been discussed, represents only the most economical, and therefore the most attractive, means of providing an additional decontamination of the air stream. There are, however, several steps in the economic range of possible facilities and these, together with approximate cost estimates for a capacity of 100,000 cfm are indicated in the next slide.

SLIDE III

VENTILATION AIR DISPOSAL SYSTEMS

Ventilation Air Treatment	Direct Installation Costs* (100,000 cfm)
1. Direct discharge to stack.	
2. Standby filter....occasional 99% decontamination.	$100,000
3. Main line, deep bed, fibrous filter....99% decontamination.	$250,000
4. Main line, deep bed, fibrous filter....99.99% decontamination.	$375,000
5. Main line sand filter.	$750,000

* Exclusive of overhead.

Note: (1) The premise is made that vessel vent gases will be filtered at their source.

(2) The estimates for items 2, 4, and 5 were prepared by personnel of the Estimating Unit at Hanford Atomic Products Operation and the estimate for item 3 is based upon an interpretation of the data contained in these estimates.

In view of the large cost differentials involved in the use of these various systems, it has been the consensus of opinion that the proposed detailed study of the most recently installed ventilation system, which will be conducted to provide guidance for future plant construction, represents an investigation which was both indicated and required; and results of this study will be awaited with interest.